Attorney Docket No. 42390.P12912

APPLICATION FOR UNITED STATES LETTERS PATENT

FOR

MOBILE COMPUTER WITH AN INTEGRATED MICRO PROJECTION DISPLAY

Inventor: Ralph M. Kling

Prepared by: Blakely, Sokoloff, Taylor & Zafman LLP
12400 Wilshire Boulevard
Los Angeles, CA 90025-1026
(408) 720-8300

"Express Mail" mailing label number: EL 867 652 601 US
Date of Deposit: December 14, 2001
I hereby certify that I am causing this paper or fee to be deposited with the United States Postal Service "Express Mail Post Office to Addressee" service on the date indicated above and that this paper or fee has been addressed to the Commissioner for Patents, Washington, D. C. 20231

Maureen R. Pettibone
(Typed or printed name of person mailing paper or fee)
Maureen R. Pettibone
(Signature of person mailing paper or fee)
12/14/01
(Date signed)

MOBILE COMPUTER WITH AN INTEGRATED MICRO PROJECTION DISPLAY

FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of computer systems. More particularly, the present invention relates to a method for a mobile computer with an integrated micro projection display.

BACKGROUND OF THE INVENTION

[0002] Computer systems have become increasingly pervasive in our society. The processing capabilities of computers have increased the efficiency and productivity of workers in a wide spectrum of professions. As the costs of purchasing and owning a computer continues to drop, more and more consumers have been able to take advantage of newer and faster machines. Furthermore, many people enjoy the use of notebook computers because of the freedom. Mobile computers allow users to easily transport their data and work with them as they leave the office or travel. This scenario is quite familiar with marketing staff, corporate executives, and even students.

[0003] As people work outside of their traditional office, they often find themselves sharing their data or making presentations. However, display technology for mobile computers has lagged behind that for desktop machines. The present mobile display screens are generally difficult to view by anyone other than the sole user sitting directly in front of the display. **Figure 1A** is an illustration of a typical prior art mobile computer system **102**. Mobile computer **102** has a single flat display screen that can be positioned for viewing by a single user. Even with multiple screen adjustments, viewing what is on

the screen can be somewhat of a chore. Someone trying to look at the display from an angle may not be able to see what is illustrated.

[0004] But if the user is trying to share information displayed on the screen, there may be times when numerous pairs of eyes are trying to view the same display screen. Some users have resorted to other types of displays. **Figure 1B** is an illustration of another prior art mobile computer system **150**. Mobile computer **152** is connected to a desktop computer monitor **154**. The computer **152** is also connected to a large external projection system **156** to project images on a movie screen **158**. All this extra computer equipment is necessary in order to share the graphical data of a mobile computer. Thus the sharing of visual information in existing prior art systems is very cumbersome.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present invention is illustrated by way of example and not limitations in the figures of the accompanying drawings, in which like references indicate similar elements, and in which:

[0006] **Figure 1A** is an illustration of a typical prior art mobile computer system;

[0007] **Figure 1B** is an illustration of another prior art mobile computer system;

[0008] **Figure 2** is an illustration of a mobile computer system with an integrated micro projection display in accordance with one embodiment of the present invention;

[0009] **Figure 3A** is an illustration of another embodiment of a mobile computer having a micro projection display in an easy-to-carry shape;

[0010] **Figure 3B** is a block diagram of the innards for the base unit of **Fig. 2** or **3A**;

[0011] **Figure 3C** is a block diagram of the computing subsystem of **Fig. 3B**; and

[0012] **Figure 4** is a flow diagram showing one embodiment of a method for a mobile computer system with an integrated micro projection display in accordance with the present invention.

DETAILED DESCRIPTION

[0013] A method for a mobile computer system with an integrated micro projection display is disclosed. The embodiments described herein are described in the context of a mobile computer system, but are not so limited. Although the following embodiments are described with reference to a mobile computer, other embodiments are applicable to other computers. The same techniques and teachings of the present invention can easily be applied to other types of circuits or systems that can benefit from a smaller form factor and lower costs.

[0014] In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. One of ordinary skill in the art, however, will appreciate that these specific details are not necessary in order to practice the present invention. In other instances, well known electrical structures and circuits have not been set forth in particular detail in order to not necessarily obscure the present invention.

[0015] Mobile computers are being used in a variety of business and home applications. One of the major components in a notebook machine is the display screen. Embodiments of the present invention combine a portable computing device, such as a notebook computer, with an integrated micro projection display. Thus, the liquid crystal display (LCD) typically found on notebook computers can be replaced with an integrated projector. Such a projector provides a smaller, light, lower power, and cheaper alternative to the large, bulky, power consuming, and expensive glass display. For one embodiment, the projector can project an image of the computer graphics onto a small detachable screen about a foot from the unit. The micro projector of one embodiment

employs an optical system similar to regular projectors, but smaller in size and light output. The optical system can thus be designed to fit inside a mobile platform. The micro projection system can be attached to the standard video output of the computer in place of the LCD screen in order to share graphics electronics and reduce costs. The LCD screen can be a significant portion of the price tag for a mobile computer. By deleting the LCD screen, the price of a mobile computer can drop by a great percentage. The micro projector is integrated with the base electronics of the computing device. The semiconductor devices of micro projection systems can also be cost competitive with existing LCDs. Such semiconductor image devices are small in size and can further scale with process technologies, driving manufacturing costs down. As the technology progresses, the size of viewable images that can be projected may be scaled upwards.

[0016] Projection technology decouples the size of the display device from the size of the image itself. Existing notebook form factors need to accommodate the size of the physical glass display screen. Embodiments in accordance with the present invention allow notebook computers to be built substantially smaller than the size of the projected image. Depending on the type of projector included in each particular implementation, the integrated micro projector may consume less power than a traditional backlit LCD screen of comparable viewing area. Furthermore, an integrated micro projector can also weigh much less than a glass LCD screen. Such differences become more pronounced as the size of the viewable area grows.

[0017] **Figure 2** is an illustration of a mobile computer with an integrated micro projection display in accordance with one embodiment of the present invention. The term mobile computer is in reference to generally portable computer systems such as

notebook computers, laptop computers, sub-notebook computers, handheld computers, and palmtop computers, but is not limited as such. The system **200** shown in this example comprises of a mobile computing unit **202**, wireless keyboard **204**, wireless mouse **206**, and portable projection screen **210**. The mobile computing unit **202** of this embodiment has a wireless transceiver and micro projection unit incorporated into the computing module **202**. The wireless transceiver is to communicate via wireless links **208** with the keyboard **204** and mouse **206**.

[0018] The micro projection unit located in the mobile computing unit **202** is to project the graphical information that is typically displayed on monitors and LCD screens. In this case, the micro projector is to provide front projection of images, but other embodiments can also have rear projection. Technologies for such a micro projector can include various types of micro displays such as mirror devices, liquid crystal on semiconductor (LCOS) devices, and laser projection devices. An example LCOS device uses electricity to change light beams. When a light is shone on the silicon, the light is reflected through optics to form an image. The light source of one embodiment has enough power to provide an image approximately the same size as a regular notebook LCD screen, but still be low power.

[0019] The information is projected from the internal projector of the mobile computing unit **202** onto a passive screen **210**. The projection screen **210** of this embodiment can be easily rolled or folded up and transported with the computing unit **202**. The screen **210** can be temporarily mounted onto a wall or fixed onto a detachable stand. For another embodiment, the passive screen **210** is a springy, flexible type of screen that can be folded up. However, a projection screen may not be needed. The

micro projector of an alternative embodiment can project onto a blank white space such as a conference room wall. This integrated micro projector allows a user to share the screen contents with others in small group settings because the projected image does not have the viewing angle limitations often found in LCD screens. The distribution of light for viewing can be better in a projection system. A user can vary the size and brightness of a projected image by simply moving the white screen **210** closer or further away from the micro projector in the computing unit **202**.

[0020] **Figure 3A** is an illustration of another embodiment of a mobile computer having an incorporated micro projector. The computer **300** of this embodiment is shown in a closed configuration. During normal use, the computer **300** can be opened up and positioned. Because embodiments in accordance with the present invention are constrained with physical restrictions, computers can be designed into non-traditional form factors. For instance, almost all existing mobile computers are flat and rectangular in shape. These mobile computers have a clamshell configuration wherein the top leaf is a LCD screen and the bottom leaf is a keyboard. The driving forces behind this form factor are the size of the keyboard and the size of the size/type of display. For example, if a full size 101 key keyboard is included with the mobile computer, the surface area of the computer has to be large enough to hold all of the keys. Similarly, the dimensions of the screen generally extend to the very length and width dimensions of the computer case in order to maximize the viewable area. Thus, the size of mobile computers is constrained and cannot be reduced without making valuable concessions in the display screen dimensions or the keyboard size.

[0021] By including a micro projector in accordance with the present invention, embodiments of mobile computers can eliminate the built-in flat LCD display screen. The one to one relationship between the size of the computer case and the viewable image can be broken when the LCD screen is removed. The use of a wireless keyboard to receive user input further eliminates the physical constraints of the mobile computer. A foldable keyboard can also be used with such a mobile computer system. Thus embodiments of computer systems in accordance with the present invention can have different shapes and smaller sizes. For example, the mobile computer **300** of this **Fig. 3A** is designed with a round cylindrical shape. This mobile computer **300** comprises of a base unit **302**, a screen **304** and a flexible keyboard/mouse **306**. The base unit **302** includes a processor, micro projector, and a wireless module.

[0022] The incorporated micro projector provides the functionality of the traditional LCD display screen by projecting the display on a surface without the need for a rigid LCD display panel. The wireless module allows the use of wireless peripherals such as a wireless keyboard and mouse with the mobile computer **300**. In the closed configuration, the screen **304** is wrapped around the base unit **302** and the flexible keyboard/mouse **306** are wrapped around the outer surface. During normal use, the mobile computer system **300** is opened and laid out. The keyboard/mouse **306** are removed from the system and unrolled to input data. The passive display screen **304** is unrolled from the base unit **302** and set into place. The base unit **302** is positioned to aim the built-in micro projector at the screen **304**. As the mobile computer **300** operates, the micro projector projects graphics and video to the display screen **304**. The ability to design mobile computers with alternative form factors allows for the inclusion of a full size keyboard and a large

viewable display with a mobile system while reducing the overall size and dimensions of the computer itself.

[0023] Embodiments of mobile computing systems designed in accordance with the present invention can benefit from reductions in size, weight, and power consumption requirements of current portable computers. LCD screens can consume an enormous amount of power, especially if the brightness/contrast is turned up to maximum settings while the system is operating on battery power. The micro projection devices incorporated in embodiments of the present invention are small, low power projection devices. Because these micro projectors are small and low power, the overall mobile computer itself can also be designed smaller, lighter, and with improved battery life. Alternative battery packs having greater efficiency can be used in these mobile computers as the form factors develop. Present mobile machines usually have some type of flat or skinny battery due to the shape of the computer. These flat batteries can be inefficient in holding large amounts of charge. With the advent of mobile computers that are free from the physical restrictions of the glass screen, batteries of other shapes and dimensions can be used with these mobile systems. Furthermore, different form factors of the computer system can allow for larger heat sinks and other power dissipation schemes not presently available to thin mobile machines.

[0024] **Figure 3B** is a block diagram of the innards for the base unit **302** of **Fig. 3A**. The base unit **302** in this embodiment comprises of two portions: a computing subsystem **310** and an optical subsystem **320**. Both subsystems are housed together in the base unit. The computing subsystem **310** is to perform the conventional functions of a computer. The computing subsystem **310** comprises a processor **312**. Coupled to the processor is an

I/O controller **314** to interface with peripheral I/O devices. Memory **316** to store data and instructions is also coupled to processor **312**. A graphics controller **318** to handle the graphical data is coupled to the processor **312**. The computing subsystem **310** is coupled to the optical subsystem **320**. A light source **325** in the optical subsystem **320** is coupled to a light modulator **321**.

[0025] The graphics controller **318** of the computing subsystem **310** is also coupled to the light modulator **321**. In one embodiment, the graphics controller **318** has its own frame buffer for storing the display data. A frame buffer or other storage can also reside within the optical subsystem **320**. The light source **325** provides light to the light modulator **321**, which is to modulate the rays of light in response to commands and data from the graphics controller **318**. For one embodiment, the light source **325** is a low power light. The optics **323** is to receive modulated light from the light modulator **321**. The optics **323** of the optical subsystem **320** is to project the modulated light to a display screen for viewing. For alternative embodiments, other types of light transducers can be used in the optical subsystem **320**.

[0026] Referring now to **Figure 3C**, an exemplary computing subsystem **310** is shown. Subsystem **310** is representative of processing systems based on the PENTIUM® III, PENTIUM® 4, Itanium™, or StrongARM™ microprocessors available from Intel Corporation of Santa Clara, California, although other systems (including PCs having other microprocessors, engineering workstations, set-top boxes and the like) may also be used. In one embodiment, sample subsystem **310** may execute a version of the WINDOWS™ operating system available from Microsoft Corporation of Redmond, Washington, although other operating systems and graphical user interfaces, for example,

may also be used. Thus, the present invention is not limited to any specific combination of hardware circuitry and software.

[0027] **Figure 3C** is a block diagram of the computing subsystem **310** in the base unit **302** of one embodiment of a mobile computer system **300** having a micro projection display in accordance with the present invention. The processor **312** includes an internal cache memory **313**. The present embodiment is described in the context of a single processor mobile system, but alternative embodiments can be included in a multiprocessor system. Subsystem **310** is an example of a hub architecture. The computing subsystem **310** includes a processor **312** to process data signals. The processor **312** can be a complex instruction set computer (CISC) microprocessor, a reduced instruction set computing (RISC) microprocessor, a very long instruction word (VLIW) microprocessor, a processor implementing a combination of instruction sets, or other processing device, such as a digital signal processor, for example. The processor **312** is coupled to a processor bus **330** that transmits data signals between the processor **312** and other components in the system **310**. The elements of subsystem **310** perform their conventional functions well known in the art.

[0028] Computing subsystem **310** includes a memory **316**. Memory **316** can be a dynamic random access memory (DRAM) device, a static random access memory (SRAM) device, flash memory device, or other memory device. Memory **316** can store instructions and/or data represented by data signals that can be executed by the processors **312**. A cache memory **313** can reside inside the processor **312** to store data signals stored in memory **316**. Alternatively, in another embodiment, the cache memory can reside external to the processor **312**.

[0029] A system logic chip **326** is coupled to the processor bus **330** and memory **316**. The system logic chip **326** in the illustrated embodiment is a memory controller hub (MCH). The processor **312** can communicate to the MCH **326** via a processor bus **330**. The MCH **326** provides a high bandwidth memory path **328** to memory **316** for instruction and data storage and for storage of graphics commands, data and textures. The MCH **326** is to direct data signals between the processor **312**, memory **316**, and other components in the subsystem **310** and to bridge the data signals between processor bus **330**, memory **316**, and system I/O **314**. In some embodiments, the system logic chip **326** provides a graphics port for coupling to a graphics controller **318**. The graphics card **318** is coupled to the MCH **334** through an Accelerated Graphics Port (AGP) interconnect **324**.

[0030] Subsystem **310** uses a proprietary hub interface bus **322** to couple the MCH **326** to the I/O controller hub (ICH) **314**. The ICH **314** provides direct connections to some I/O devices. Some examples are the audio controller, firmware hub (flash BIOS) **334**, data storage **342**, legacy I/O controller containing user input and keyboard interfaces, a serial expansion port such as Universal Serial Bus (USB), and a network controller **336**. The data storage device **342** can comprise a hard disk drive, a floppy disk drive, a CD-ROM device, a flash memory device, or other mass storage device.

[0031] For the embodiment of a computing subsystem **310** in **Fig. 3C**, a wireless transceiver **332** is also coupled to the ICH **314**. The wireless transceiver **332** is capable of receiving and transmitting wireless signals to and from the system **300**. Control of this transceiver **332** resides with software located in the transceiver logic and memory **316**. Processor **312** can execute instructions from memory **316** that cause the processor **312** to

send data to and request from the wireless transceiver **332**. Furthermore, the wireless transceiver **332** can interact with other system components including the audio controller, network controller **336**, and I/O controllers as needed when the system is in control of external wireless I/O devices. For example, the keyboard controller can request keyboard input data from a wireless keyboard via the wireless transceiver **332**. The operating system and device driver software can also interface with the wireless transceiver **332**. The wireless transceiver enables the computer system **300** to communicate with other computers and devices that have wireless capability. For one embodiment, the wireless transceiver conforms to the Bluetooth communication protocol.

[0032] For another embodiment of a system, one implementation of a mobile computer with can be used with a system on a chip. One embodiment of a system on a chip comprises of a processor and a memory. The memory for one such system is a flash memory. The flash memory can be located on the same die as the processor and other system components. Additionally, other logic blocks such as a memory controller or graphics controller can also be located on a system on a chip.

[0033] **Figure 4** is a flow chart showing one embodiment of a method in accordance with the present invention for a mobile computer with an integrated micro projection display. This example generally describes the operation of a mobile computer and integrated projector of one embodiment. At block **402**, instructions and data are fetched for execution in a computing subsystem. The instructions are executed at block **404** by a processor in the mobile computer. The processor also generates display data at step **406**. This display data is sent at block **408** to an optical subsystem. At block **410**, the graphics data is applied to the light source through a light projection device. The manipulated

light beams are processed through optics at block **412**. At block **414**, the light is projected from the optics onto a viewing surface.

[0034] The examples above have been described in the context of a single processor. In a multiprocessor system, the method can be performed concurrently in each processor.

[0035] In the foregoing specification, the invention has been described with reference to specific exemplary embodiments thereof. It will, however, be evident that various modifications and changes may be made thereof without departing from the broader spirit and scope of the invention as set forth in the appended claims. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.